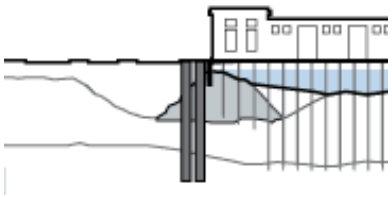
Measures Profile

Drilled Shafts

Seismic Adaptation Measure

SHORELINE STABILIZATION



TYPE: Geotechnical

SHORELINE LOCATION:

Landside

Installation of large drilled shafts to stabilize the shoreline would require large equipment as shown here - San Francisco, CA©Fugro

DESIGN LIFE	ADAPTABILITY	IMPACT ON THE WATERFRONT	CONSTRUCTION COST
75+ years	Medium	Moderate Landside Intervention	Moderate

SEISMIC HAZARDS MITIGATED:

Lateral Spreading

Liquefaction

SEISMIC PERFORMANCE IMPROVED:

Structures

Utilities and Transportation

MEASURES COMPATIBILITY:	Flood	Seismic
	Floodwalls | Raised Marine Structures	Liquefaction Mitigation | Bulkhead Wharf Retrofit | Utility Retrofit

DESCRIPTION:

Structural stabilization of existing Seawall using large diameter concrete-filled drilled shafts installed just landside of the bulkhead. This will stabilize the rock dike and reduce lateral spreading but will not stop liquefaction of the Embarcadero fill. The new shafts can be used to reinforce the existing bulkheads and serve as a future foundation for new wharves.

CONSIDERATIONS:

- The diameter of the shaft would be defined by the depth of Young Bay Mud which varies along the waterfront.
- Measure less effective in areas of deep Young Bay Mud.

ADVANTAGES:

- Stabilizes shoreline with smallest construction footprint.
- Can be used to seismically reinforce existing bulkhead wall & wharves.
- Can serve as a new foundation for future bulkhead wall & wharf replacment.

DISADVANTAGES:

- High construction impact to the Embarcadero.
- Does not mitigate liquefaction-induced settlements of Embarcadero.
- Requires some utility relocation work.

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- Seismically resilient Promenade can be supported by the shafts.
- Construction duration likely less than landside buttress shoreline stabilization measure.
- Waterfront buildings can likely remain occupied during construction.
- No in-water work.

CONSTRUCTION IMPACTS TO THE PUBLIC:

- Construction would require lengthy closure of northbound Embarcadero and Promenade.
- Southbound Embarcadero may be changed to one lane in each direction.
- Light rail may need to be closed to provide traffic/bike/pedestrian circulation space.

SEA LEVEL RISE ADAPTATION OPPORTUNITIES:

- Drilled shafts can serve as a future seismically reliable foundation to support a new raised bulkhead wharf or floodwall at the promenade.
- Groundwater cutoff can be integrated into shaft system by providing smaller diameter secant piles or soil-cement mixing between the shafts to provide a barrier for bayside sea level rise.

DESIGN CONSIDERATIONS:

- The diameter of the shaft would be defined by the depth of Young Bay Mud which varies along the waterfront.
- Measure is less effective in areas of deep Young Bay Mud.
- Consider using to reinforce the existing bulkhead wall & wharf (need seismic joint at pier and shed).
- Consider using as foundation for future bulkhead wall & wharf, design the complete system for incremental construction and built only the shaft portion now.
- Consider supporting Promenade and creating an earthquake resilient utility corridor.

SITE-SPECIFIC CONSIDERATIONS:

- Special procedures would be required in the Fisherman's Wharf area since contaminated soils below the water surface would be excavate by construction operations.
- Subsurface conditions make a large difference in size and cost, deep Young Bay Mud is very expensive.
- Where deep YBM, consider other needs for large foundation such as new storm/sewer storage capacity and resilient utility corridors.

URBAN DESIGN CONSIDERATIONS:

- Construction work to demolish surface infrastructure and to relocate utilities may provide an opportunity to rebuild the Embarcadero and promenade following a new design including reconfiguring the northbound lanes & bike lane.
- Closure of northbound Embarcadero can provide opportunity for utility and other maintenance or replacement work for seismic improvements and to prevent future disruption.

HISTORICAL RESOURCE CONSIDERATIONS:

- This measure would not impact any historical buildings nor marine structures.

INSTALLATION AND CONSTRUCTABILITY CONSIDERATIONS:

- Requires significant utility relocation work. Requires demolition and restoration of promenade.
- Large construction footprint required for equipment and materials.